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सामान्य तथा भारी इंजीनियरिंग के लिए बेलनाकार गियर्स

भाग 1 मानक आधार रेक के दाँते की प्रोफाइल

(तीसरा पुनरीक्षण)

Indian Standard

CYLINDRICAL GEARS FOR GENERAL AND HEAVY ENGINEERING

PART 1 STANDARD BASIC RACK TOOTH PROFILE

(Third Revision)

ICS 21.200

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

December 2004

Price Group 3

Transmission Devices Sectional Committee, MGP 30

NATIONAL FOREWORD

This Indian Standard (Part 1) (Third Revision) which is identical with ISO 53 : 1998 'Cylindrical gears for general and heavy engineering — Standard basic rack tooth profile' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendations of the Transmission Devices Sectional Committee and approval of the Medical Instruments, General and Production Engineering Division Council.

This standard was first published in 1963 and subsequently revised in 1969 and 1978. The second revision was in full conformity with ISO 53 : 1974 'Cylindrical gears for general and heavy engineering — Basic rack' and ISO 54 : 1977 'Cylindrical gears for general and heavy engineering — Module and diametral pitch'. In order to harmonize the standard with latest version of ISO 53 and ISO 54 the committee decided to revise the standard and split it into two parts adopting latest version of ISO Standards. This standard has now been published in following two part.

IS 2535 (Part 1) : 2004	Cylindrical gears for general and heavy engineering: Part 1 Standard basic rack tooth profile
IS 2535 (Part 2) : 2004	Cylindrical gears for general and heavy engineering: Part 2 Modules

The text of the ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear, referring to this standard, they should be read as 'Indian Standard', and

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

CROSS REFERENCES

In the adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 54 : 1996 Cylindrical gears for general and heavy engineering: Modules	IS 2535 (Part 2) : 2004 Cylindrical gears for general and heavy engineering: Part 2 Modules	Identical
ISO 1122-1 : 1998 Vocabulary of gear terms — Definitions related to geometry	IS 2458 : 2001 Vocabulary of gear terms — Definitions related to geometry (*first revision*)	do

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

CYLINDRICAL GEARS FOR GENERAL AND HEAVY ENGINEERING

PART 1 STANDARD BASIC RACK TOOTH PROFILE

(Third Revision)

Scope

This International Standard specifies the characteristics of the standard basic rack tooth profile for cylindrical involute gears (external or internal) for general and heavy engineering.

This International Standard applies to the standardized modules specified in ISO 54.

The defined profile does not take into account the possible cut-off of the height of internal teeth. This height is to be calculated for each case.

The standard basic rack tooth profile defined in this International Standard constitutes a geometrical reference for a system of involute gears in order to fix the sizes of their teeth. It does not constitute a definition of a cutter, but a cutter may be defined from this standard basic rack tooth profile in order to realize a conforming profile.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 54:1996, *Cylindrical gears for general and for heavy engineering — Modules.*

ISO 1122-1:1998, *Vocabulary of gear terms — Part 1: Definitions related to geometry.*

3 Terms and definitions

For the purposes of this International Standard, the terms and definitions given in ISO 1122-1 and the following apply.

3.1
standard basic rack tooth profile

tooth profile normal section through the teeth of a basic rack which corresponds to an external gear with number of teeth $z = \infty$ and diameter $d = \infty$

Figure 1.

NOTE — The tooth of the standard basic rack tooth profile is bounded by the tip line at the top and by the parallel root line at the bottom. The fillet between the straight part of the profile and the root line is a circular arc with a radius equal to ρ_{fP}.

3.2
mating standard rack tooth profile
rack tooth profile symmetrical to the standard basic rack tooth profile about the datum line P-P and displaced by half a pitch relative to it

Figure 1.

4 Symbols and units

See table 1.

Table 1 — Symbols and units

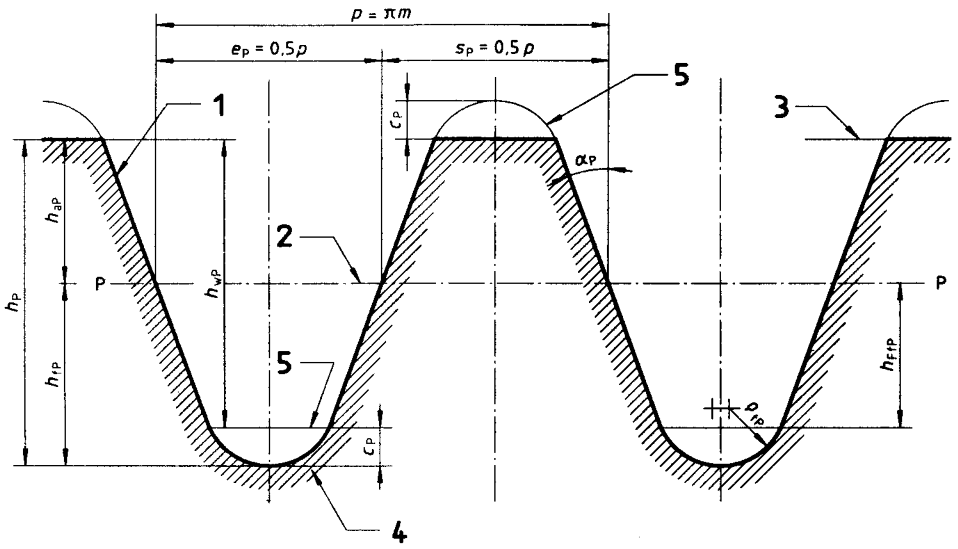
Symbol	Description	Unit
c_P	Bottom clearance between standard basic rack tooth and mating standard basic rack tooth	mm
e_P	Spacewidth of standard basic rack	mm
h_{aP}	Addendum of standard basic rack tooth	mm
h_{fP}	Dedendum of standard basic rack tooth	mm
h_{FfP}	Straight portion of the standard basic rack tooth dedendum	mm
h_P	Tooth depth of standard basic rack	mm
h_{wP}	Common depth of standard basic rack and mating standard basic rack tooth	mm
m	Module	mm
p	Pitch	mm
s_P	Tooth thickness of standard basic rack tooth	mm
U_{FP}	Size of undercut	mm
α_{FP}	Angle of undercut	degrees
α_P	Pressure angle	degrees
ρ_{fP}	Fillet radius of the basic rack	mm

5 Standard basic rack tooth profile

5.1 The characteristics of the standard basic rack tooth profile are given in figure 1 and table 2. Additional basic rack recommendations and applications are given in annex A.

5.2 The standard basic rack tooth profile with module m has a pitch $p = \pi m$.

5.3 The flanks of the standard basic rack tooth profile are straight for the section h_{aP} plus h_{FfP}.



Key

1 Standard basic rack profile
2 Datum line
3 Tip line
4 Root line
5 Mating standard basic rack tooth profile

Figure 1 — Standard basic rack tooth profile and mating standard basic rack tooth profile

Table 2 — Standard basic rack proportions

Item	Standard basic rack value
α_P	20°
h_{aP}	1 m
c_P	0,25 m
h_{fP}	1,25 m
ρ_{fP}	0,38 m

5.4 On the line P-P the tooth thickness is equal to the space-width, i.e. half the pitch.

$$s_P = e_P = \frac{p}{2} = \frac{\pi m}{2} \tag{1}$$

where

s_P is the tooth thickness of standard basic rack tooth;

e_P is the spacewidth of standard basic rack;

p is the pitch;

m is the module.

5.5 The flanks of the standard basic rack tooth profile are inclined at the pressure angle, α_P, to a line normal to the datum line P-P.

5.6 The tip line and the root line are respectively parallel to the datum line P-P at distances of h_{aP} and h_{fP}.

5.7 The active tooth depth, h_{wP}, of the standard basic rack tooth profile and the mating standard basic rack tooth profile is equal to $2h_{aP}$.

5.8 The dimensions of the standard basic rack tooth profile use line P-P as the base datum.

5.9 The fillet radius of the standard basic rack, ρ_{fP}, is determined by the standard clearance, c_P.

For a basic rack, where $\alpha_P = 20$, $c_P \leqslant 0{,}295\ m$ and $h_{FfP} = 1\ m$:

$$\rho_{fPmax} = \frac{c_P}{1 - \sin \alpha_P} \tag{2}$$

where

$\rho_{fP\,max}$ is the maximum fillet radius of the basic rack;

c_P is the bottom clearance between standard basic rack tooth and mating standard basic rack tooth;

α_P is the pressure angle.

For a basic rack, where $\alpha_P = 20°$ and $0{,}295\ m < c_P \leqslant 0{,}396\ m$:

$$\rho_{fPmax} = \frac{\left[(\pi m)/4 - h_{fP} \tan \alpha_P\right]}{\tan[(90° - \alpha_P)/2]} \tag{3}$$

where h_{fP} is the dedendum of the basic rack tooth.

The centre of $\rho_{fP\,max}$ is on the centre of the rack space.

NOTE — The actual root fillet, which is outside the active profile, can vary depending on influences such as the method of manufacturing, profile shift and number of teeth.

5.10 The dimensions of the standard basic rack tooth profile c_P, h_{aP}, h_{fP} and h_{wP} may also be quoted as a multiple of the module m, i.e. relating to $m = 1$. In this case, they are identified by an asterisk, for example

$$h_{fP} = h_{fP}^{*} \cdot m$$

Annex A
(informative)

Basic rack recommendations for various applications

A.1 Application of basic rack forms

Alternative basic rack tooth profiles may be used based on application requirements

- Standard basic rack tooth profile type A is recommended for gears transmitting high torques.
- Basic rack tooth profile types B and C are recommended for normal service. Type C may be applied for manufacturing with some standard hobs.
- Basic rack tooth profile type D is equivalent to a full radius form for the fillet. The enlarged dedendum, $h_{fP} = 1{,}4\ m$, with the associated fillet radii, $\rho_{fP} = 0{,}39\ m$, permits the finishing tool to work without interference, while maintaining the maximum fillet radius. This profile is recommended for high-precision gears transmitting high torques and consequently with tooth flanks finished by grinding or shaving. Care should be taken to avoid creating notches in the fillet during finishing, which would create stress concentrations.

Characteristics of the basic rack tooth profile types are given in table A.1.

Table A.1 — Basic rack tooth profiles

Symbol	Types of basic rack tooth profile			
	A	B	C	D
α_P	20°	20°	20°	20°
h_{aP}	1 m	1 m	1 m	1 m
c_P	0,25 m	0,25 m	0,25 m	0,4 m
h_{fP}	1,25 m	1,25 m	1,25 m	1,4 m
ρ_{fP}	0,38 m	0,3 m	0,25 m	0,39 m

A.2 Basic rack tooth profiles with undercut

A basic rack tooth profile with a chosen undercut, U_{FP}, and angle of undercut, α_{FP}, is used for gears cut by a protuberance tool and finished by grinding or shaving, see figure A.1. The specific values of U_{FP} and α_{FP} depend on influences such as the method of manufacturing, which are not specified in this International Standard.

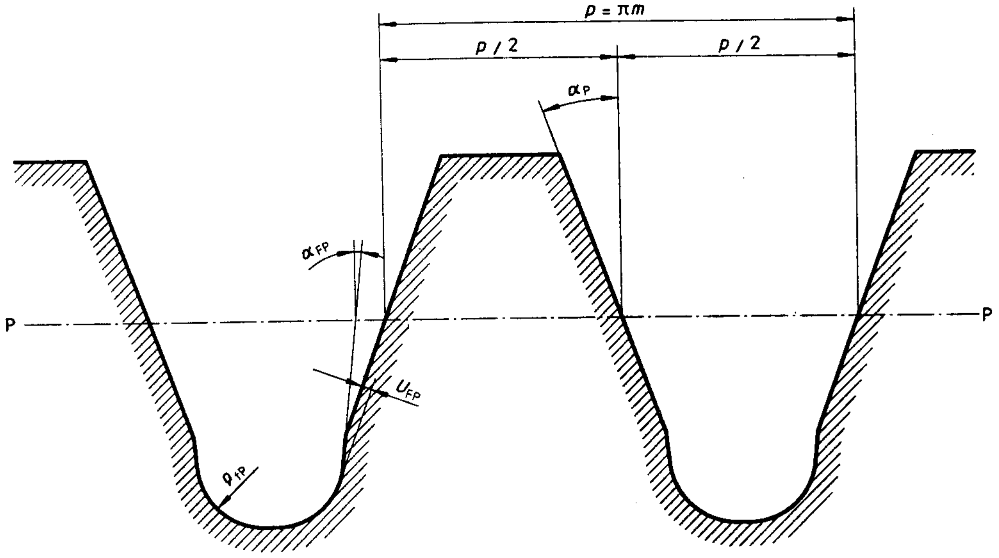


Figure A.1 — Basic rack tooth profile with a chosen undercut

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